The Virtual Employment Test Bed: An immersive synthetic environment allows engineers to test and evaluate material solutions

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ABSTRACT: *The Virtual Employment Test bed (VETB) allows engineers to test and evaluate material solutions in a realistic combination live/virtual environment, as well as the associated user performance characteristics. This program brings together current, state-of-the-art, ARDEC capabilities to form a user performance evaluation test bed where ARDEC designs will be evaluated under operational scenarios at any point in the system lifecycle.*

1. Introduction

There is always a desire to gather user test data early in the product development life cycle in order to avoid the larger costs of changing a design later. The DoD has encouraged the use of modeling and simulation as a way of achieving early insight to the capabilities or improvements of a new design.

The Virtual Employment Test bed (VETB) allows engineers to test and evaluate material solutions in a realistic combination live/virtual environment, as well as the associated user performance characteristics. This program brings together three current, state-of-the-art, ARDEC capabilities to form a user performance evaluation test bed where ARDEC designs will be evaluated under operational scenarios at any point in the system lifecycle.

2. Live Virtual Constructive Testing at the Target Behavioral Response Laboratory

Since its inception in 2004, the Target Behavioral Response Laboratory (TBRL) at Picatinny Arsenal has conducted comprehensive Live-Virtual-Constructive (LVC) studies under controlled laboratory experimentation. Construction of the live experiments is grounded in behavioral science. Human behavioral science requires close attention to the critical issues inherent in human experimentation, such as internal and external validity, experimental controls, subject selection and protection issues, and statistical power (Cooper 2012).

Behavioral scientists strive to configure the laboratory situation to systematically manipulate and capture the most relevant and fundamental factors determining behavior of the subjects. This task involves constructive simulations of the external environment of physical structures and spaces.

To create an operational environment, the capabilities of the Gaming & Interactive Technologies Multimedia (GITM) group were used to fashion an immersive synthetic environment. This environment is used to create scenarios that test a design with respect to the users' requirements.

3. The Virtual Employment Test Bed

The Virtual Employment Test Bed (VETB) provides a 180 degree wrap around environment where any ARDEC (and PM) system can be evaluated. VETB provides engineer and user jury feedback, in an operational environment to capture more realistic performance measurements. Once users have completed an exercise, their performance data, such as accuracy and reaction time, will be immediately available. System adjustments can be made and tests rerun rapidly. The VETB offers flexibility and can be altered for specific systems if necessary.

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4. Virtual Adversaries

While the typical first person shoot simulations are usually used for training, the TBRL utilizes virtual adversaries to conduct testing of the design and function of equipment. The VETB is an integration of several systems that creates a full scale targeting measurement system. The VETB is configured for data collection, including video recording equipment and motion capture cameras and sensors on guns to record trigger pulls. The test bed also includes computer control systems, video recording, motion capture (MOCAP) (Figure 4.1), audio/visual equipment, and flexible integration of stimulus devices; x, y, z location coordinates are captured in real time. This real time information allows the TBRL to test system characteristics. These methods also allow the TBRL to test the impact of platform characteristics on weapon effectiveness, for example slew rate, speed of targeting, rate of fire, etc. This capability is most useful in examining the parameters determining the effectiveness of weapons fire.

In the current configuration of the test bed and experimental design, the adversary placement is designed to evaluate the impact of changes to the Gunner Protection Kit (GPK) on targeting for convoy protection (Figure 4.1). The test bed consists of a wrap around screen that displays an immersive game simulation (Figure 4.3). Subjects are placed in the GPK; both person and gun are outfitted with motion capture sensors (Figure 4.4). Paintball guns fire at the subject from angles that correspond to the adversary fire displayed on the screen. The adversaries are positioned onscreen so that the subject will be required to swing the gun through a spectrum of angles and speeds in order to accurately aim at adversaries in the simulation. The set-up is instrumented to record time to acquire target, time to get gun on target, accuracy of aim, number of bullets expended, latency to fire, and time to acquire next target. The combination of live subjects operating a real GPK and a 50-caliber gun shooting air bullets against Virtual Adversaries allows testing of the full range of targeting functions and weapon performance.

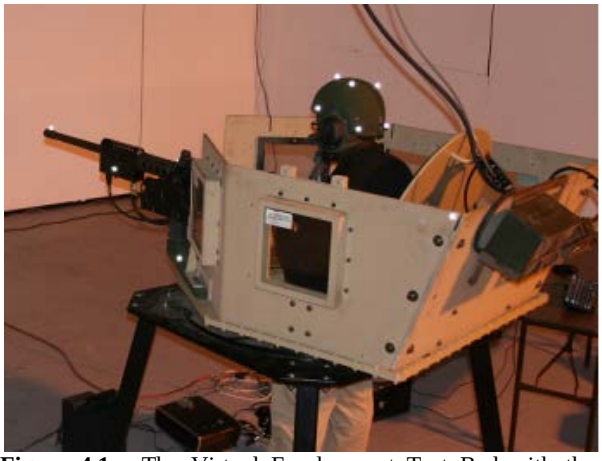

Figure 4.1: The Virtual Employment Test Bed with the GPK. The glowing spheres allow motion capture of subject and gun movement by the cameras mounted on the tops of the wall.

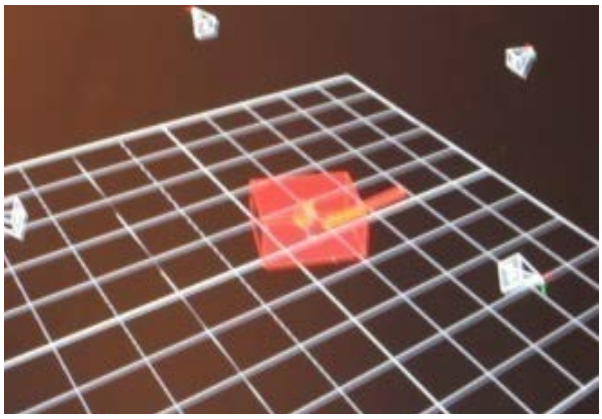

Figure 4.2: Motion capture coordinates.

5. VETB and Decision Support

The VETB experiment is constructed to allow TBRL to collect data that is analyzable—including experimental control over conditions, same comparable conditions, repeated measures, number of subjects with sufficient statistical power, and comparison baseline conditions.
The LVC data collected allow for statistical analyses and data-based decisions for acquisition, training, doctrine, and commander decisions. Standard benchmarks can be created and alternative options can be compared using numbers and statistics. These quantitative analyses can then serve as a basis for support for decisions across DoD. The production of quantitative data for appropriate decision-making is the greatest benefit for the use of LVC methods for testing. The VETB data also can be used in developing decision support modeling and simulation tools (Mezzacappa, et al, 2012; Riedener & Mezzacappa, 2012).

Figure 4.3 The Virtual Employment Test Bed with the GPK. Subjects target adversaries displayed on video projections upon the wrap around screens. Trigger pulls and aim on the screen are recorded. Live fire paintball guns are mounted on top of the walls. Picture by Todd Mozes.

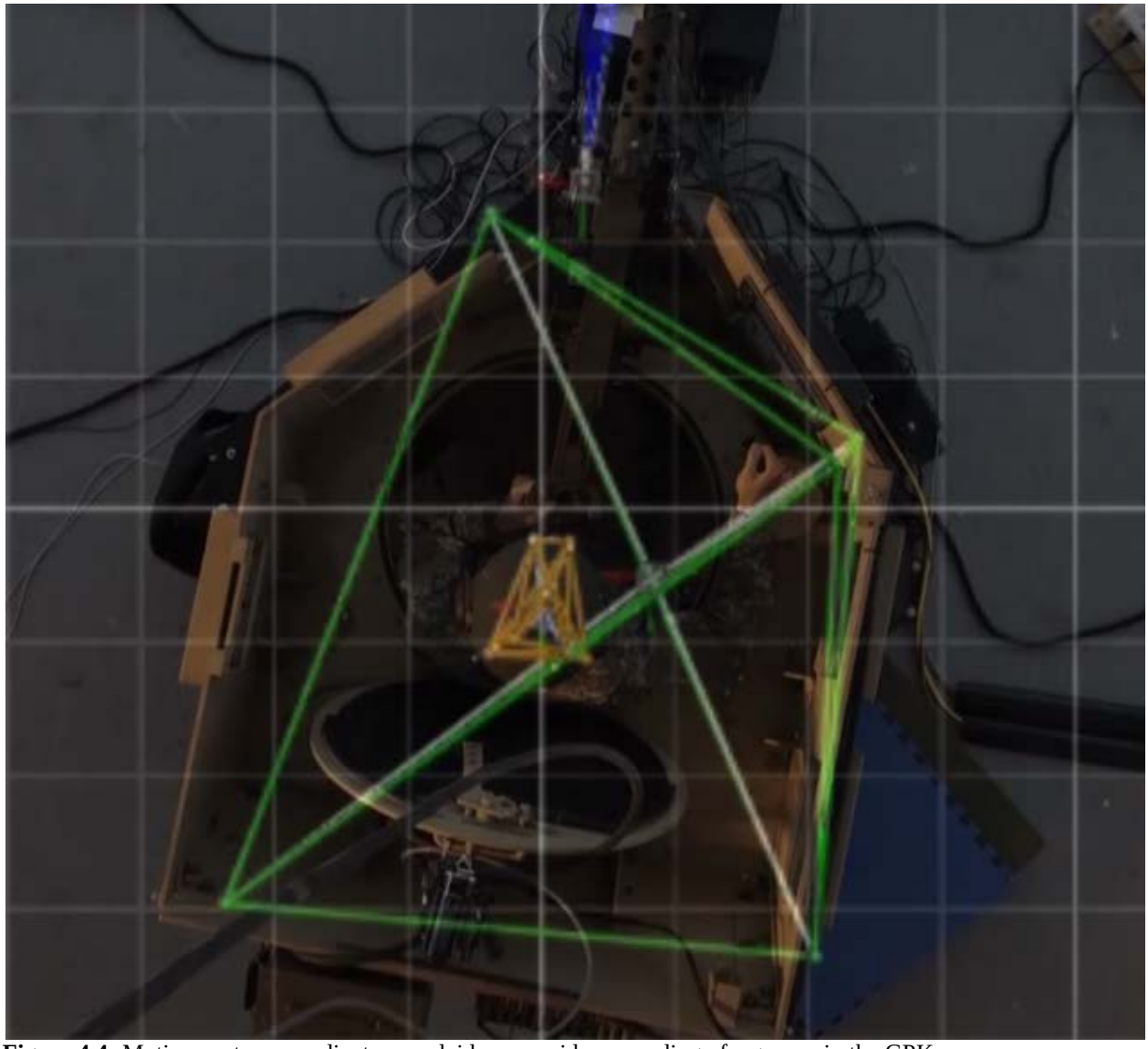

Figure 4.4: Motion capture coordinates overlaid over a video recording of a gunner in the GPK.

6. References

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